

Table 1

Responses of *Rostanga pulchra* to *Ophlitaspongia pennata* treatments in a Y-maze. Treatment vehicles were rocks for sponges and agar blocks for extracts; controls for each treatment were bare rocks or agar blocks with solvent only. Significant differences in slug position were tested via χ^2 tests with continuity correction. See Methods section for details.

Treatment	Stimulus position	Slug position		χ^2	P
		Left	Right		
Whole Sponge	Left	10	1	5.860	0.016
	Right	3	7		
Sponge Extract	Left	11	2	4.868	0.027
	Right	4	8		
Nonpolar Fraction	Left	12	0	7.106	0.008
	Right	4	6		

Results

Approximately 80% of the nudibranchs chose the treatment arm in each experiment. The stimulus position significantly affected which arm the slug chose (Table 1). The slugs also preferred the left arm of the maze, possibly due to slight differences in the flow rate. Allocation of treatments to each arm was roughly 50%.

Discussion

R. pulchra is attracted to whole *O. pennata*, confirming the results of Cook (1962) and Anderson (1971). In Anderson's assays, it is interesting that *R. pulchra* was not attracted to *E. originalis*, another prey sponge containing the correct mix of carotenoids; this may be due to the motivation of the animals, or the arena she used. *R. pulchra* also responds to isolated compounds from this sponge, suggesting that chemotaxis is an important means of prey location for this nudibranch. Further, it responds to non-polar compounds at a level equivalent to that for whole extracts; to our knowledge, this is the first report of non-polar attractants for a carnivorous gastropod. The attractive compounds are possibly the sequestered carotenoids, as another nudibranch is attracted to the more polar compounds sequestered from its prey (Carté & Faulkner, 1986). If *R. pulchra* is attracted to these highly insoluble carotenoids, it would suggest extreme adaptation to detect at a distance the compounds sequestered from prey.

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Pseudorhaphitoma kilburni (Mollusca: Gastropoda: Turridae), New Species from Yemen, Red Sea

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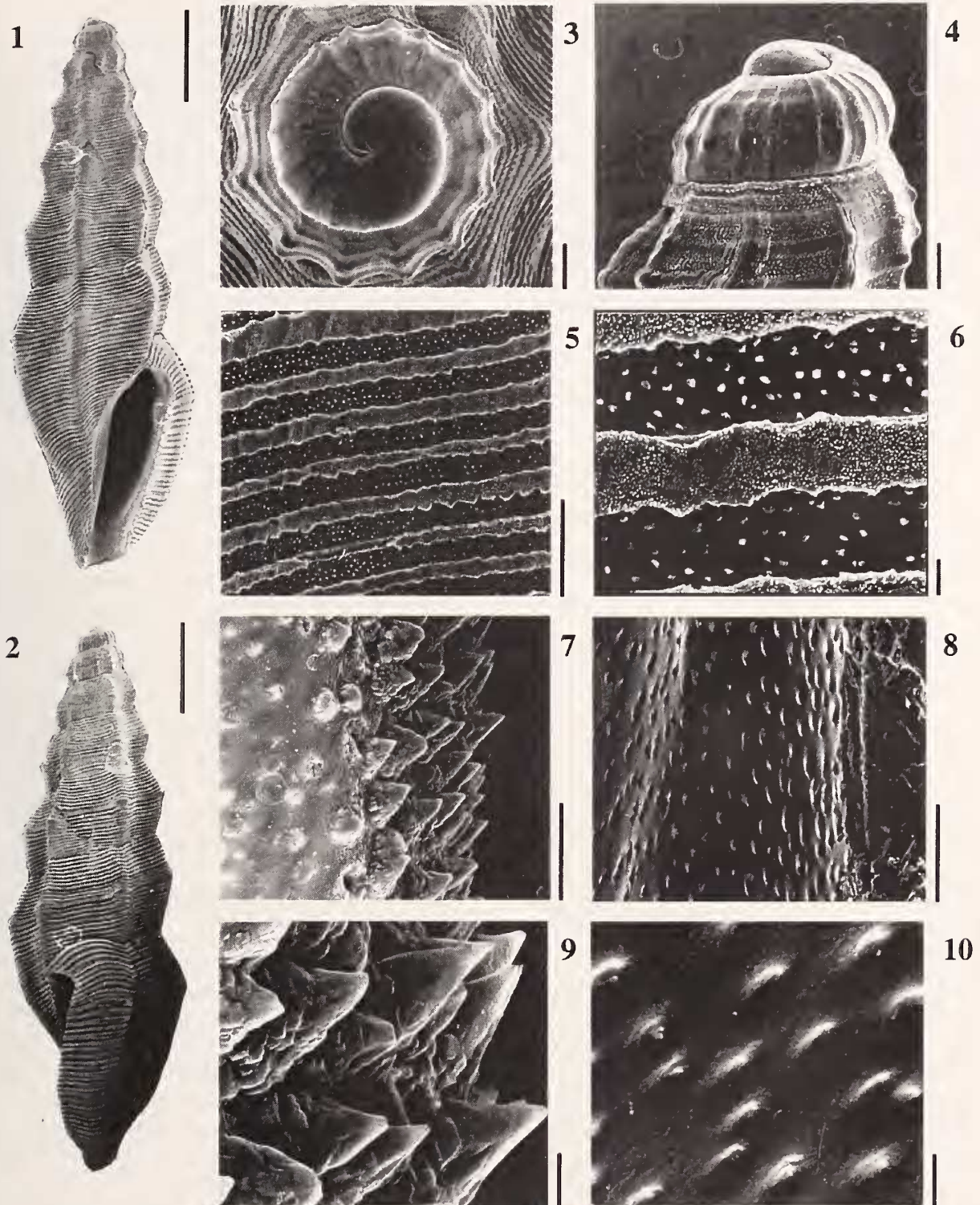
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Although the molluscan fauna of the Red Sea has been quite extensively investigated during more than two centuries, knowledge of the turrid fauna has remained rather poor. This work is intended to present the shells belonging to an unknown turrid species that have been sorted out from dredge samples collected during a marine survey in the Red Sea (Red Sed '92 European Community Project, September 1992, Gulf of Aden and South Red Sea, French oceanographic ship *Marion Dufresne*).

Almost all of the conchological characters of the present species are indicative of the mangeliine genus *Pseudorhaphitoma* Boettger, 1895; nevertheless, they are quite distinct from *Pseudorhaphitoma iodolabiata* (Hornung & Mermod, 1928), the only *Pseudorhaphitoma* previously known from the Red Sea, and those of any other de-



Figures 1–10. *Pseudorhaphitoma kilburni* Morassi & Bonfitto, *sp. nov.* Figures 1, 2. Holotype MZB 12757; scale bar 1 mm. Figures 3, 4. Protoconch; scale bar 100 μ m. Figure 5. Microsculpture of teleoconch; scale bar 100 μ m. Figure 6. Microsculpture of teleoconch; scale bar 10 μ m. Figure 7. Portion of labial callus; scale bar 50 μ m. Figure 8. Interior part of outer lip; scale bar 50 μ m. Figure 9. Parietal prickly nodules; scale bar 10 μ m. Figure 10. Pustules of interior part of outer lip; scale bar 10 μ m.

scribed species particularly *P. stipendiarii* Kilburn, 1993, from Southern Africa, which this species resembles.

In this paper we have hesitantly used the traditional classification rather than that proposed by Taylor et al. (1993). Rosenberg (1998) critiqued their methodology of analysis and showed that their results cannot be reproduced. Nevertheless, Taylor et al. (1993) recognized little anatomical evidence supporting the separation of the higher turrids from the Conidae.

Abbreviations: a/l = ratio of aperture length to total shell length; b/l = ratio of shell breadth to total length; AMSA = The Australian Museum, Sydney; ANSP = Academy of Natural Sciences of Philadelphia; BMNH = The Natural History Museum, London; MNHN = Muséum National d'Histoire Naturelle, Paris; MZB = Museo di Zoologia dell'Università di Bologna; NMSA = Natal Museum, Pietermaritzburg.

Family TURRIDAE H. & A. Adams, 1853

Subfamily MANGELILINAE, Fischer, 1883

Genus *Pseudorhaphitoma* Boettger, 1895

Pseudorhaphitoma Boettger, 1895 (as subgenus of *Clathurella*): Type species: *Mangelia fairbanki* G. & H. Nevill, 1875 (o.d.) *Turrella* Laseron, 1954

Type species: *Clathurella tenuilirata* Angas, 1871 (o.d.)

Pseudorhaphitoma kilburni Morassi & Bonfitto,
sp. nov.

(Figures 1–10)

Diagnosis: Shell mangeliine, with angular whorls sculptured with six sharp axial ribs continuous from whorl to whorl. Surface covered by thin spiral lirae with irregular edges, narrower than interstices. Eleven to 13 on first whorl; 17–23 on penultimate. Aperture narrow, outer lip with a rounded tubercle. Anal sinus U-shaped. Protoconch sculptured by axial riblets cut into nodules by four spiral ridges; maximum diameter 0.67 mm. Ground color pale-flesh; base and aperture whitish. Maximum length 6.1 mm.

Description: Shell moderately small for genus (4.1–6.1 mm), with a high, orthoconic spire and a distinctly produced, obliquely truncate base. Teleoconch of 4.5–5 whorls without shoulder. Suture shallow and slightly undulating. Whorls with a strong peripheral angle situated at or just below mid whorl, evenly convex anterior half and slightly concave shoulder slope. Aperture narrow, distinctly restricted into an embayment in its posterior end by the presence of parietal and labral nodules. Siphonal canal moderately short and wide, rather straight and shallowly indented, with its termination slightly obliquely truncate. Left side of base shallowly concave, not notched by rib intervals. Columella rather long and straight. Labial callus fairly thin, with rows of prickly

nodules in its interior part becoming blunted by abrasion exteriorly where they are somewhat vesicular in structure. Parietal callus filling posterior angle of aperture forming a feeble tubercle. Outer lip convex with a labral tooth just anterior to anal sinus and preceded by thick, varicoid rib. Edge of lip sharp, evenly arched, devoid of denticles, bearing, under strong magnification, microscopic, somewhat prickly pustules. Anal sinus deep for genus, symmetrically U-shaped, occupying most of shoulder slope. Axial sculpture of six strong ribs with sharply angular crests, continuous from whorl to whorl, and reaching on body whorl the base of siphonal rostrum. Ribs very weakly sinuous and opisthoclinal, much narrower in width than their interstices, which are wide and distinctly concave. Entire surface covered by thin, dense, tabulate spiral lirae, narrower or subequal in width to their interstices, bearing axially elongated plicules. Plicules fused together, giving edges of lirae very irregular nodose-pliculate appearance but not projecting laterally.

Spiral lirae sculptured by very numerous microscopic pores. Interstices between lirae with microscopic, spirally aligned granules. Peripheral angle characterized by presence of a main spiral lira, developed into a peripheral keel. Eleven to 13 lirae present on first teleoconch whorl; 17–23 on penultimate; base of body whorl with about 30–35 lirae. Ground color pale-flesh; base and aperture whitish. Protoconch bluntly conical, of about 1.6–2 whorls (termination not well defined) with rather deep suture. First whorl distinctly flattened but initially projecting sideward, second convex. Sculpture consisting of arcuate, orthoclinal axial riblets cut into rounded granules by four spiral ridges of which the median is the strongest. Breadth: 0.52–0.67 mm; height: 0.40–0.62 mm. Soft parts unknown.

Measurements (in mm):

	Length	Breadth	Aperture	b/l	a/l
Holotype	6.1	2.1	2.2	0.34	0.36
Paratypes	4.1–5.5	1.7–2	1.8–2	0.34–0.41	0.36–0.40

Type locality: Red Sea, offshore Yemen (14°46'72"N, 42°32'82"E), 76 m depth on muddy sand.

Type material: 27 adult and juvenile specimens from type locality. Holotype: MZB 12757, Paratypes: 21 MZB 12758; 1 AMSA; 1 ANSP; 1 BMNH; 1 MNHN; 1 NMSA L4787/T1577.

Etymology: Named after Dr. R. N. Kilburn of the Natal Museum in recognition of his substantial contribution to our knowledge of the Turridae *s.l.*

Discussion: *Pseudorhaphitoma* Boettger, 1895, was originally introduced as a subgenus of *Clathurella* Carpenter, 1857, with *Mangelia fairbanki* G. & H. Nevill, 1875, from Bombay, as the type species. Subsequently, Hedley (1922) in his revision of the Australian turrids regarded

Pseudorhaphitoma as worthy of full generic status, whereas Thiele (1925) used it as a subgenus of *Mangelia* Risso, 1826. Wenz (1943) reported the genus under the incorrect spelling of *Pseudoraphitoma*, followed in this by all modern turrid workers except Kilburn (1993). Laseron (1954:42) considered *Pseudorhaphitoma* a well defined genus because of its sculpture of axial ribs continuous from whorl to whorl. He also introduced the new genus *Turrella* for temperate water species from New South Wales and Tasmania. Powell (1966:107) noticed the resemblance between the genera but retained both as valid, and reported lists of characteristic species. More recently, Taylor et al. (1993:167) referred both taxa to the family Conidae. Kilburn (1993) synonymized *Turrella* with *Pseudorhaphitoma* and showed the presence, within the genus, of several intergrading types of spiral sculpture of the teleoconch and the protoconch. At present, the authors consider *Pseudorhaphitoma* as a rather heterogeneous assortment of at least 50 described species, ranging from the Indian Ocean to the Pacific Ocean, grouped together almost entirely on shell features, which are poorly defined. Very likely, when the anatomy of these species becomes known, a rearrangement of the complex will be necessary. At present, it is preferable to use *Pseudorhaphitoma* in a broad sense rather than erect new and doubtful genera or subgenera.

In its narrow form, acute axial ribbing, and well defined peripheral keel, the new taxon more closely resembles species of the western Atlantic genus *Ithycythara* Woodring, 1928, than any other described *Pseudorhaphitoma* species. However, as pointed out by Kilburn (1993), members of *Ithycythara* have a much finer spiral sculpture of microscopic striae and fewer basal threads.

Because of its rather characteristic protoconch (corresponding to "type C" of Kilburn, 1993) (Figures 3, 4) the species here described is referable to a small group of species represented by *Pseudorhaphitoma perlonga* (Melvill, 1899), *P. scitula* (E. A. Smith, 1884), and *P. stipendiarii* Kilburn, 1993. Among these, it could be reasonably confused only with the latter, described from Northern Zululand, South Africa, which it most closely resembles. From that species, *P. kilburni* sp. nov. can be separated by being smaller (4.1–6.1 mm versus 5.6–7.2 mm) and narrower (1.7–2.1 mm versus 2.1–2.3 mm) with a much stronger peripheral angle and a protoconch differing in shape and sculpture. In *P. stipendiarii*, the axial riblets of the protoconch are rendered strongly tuberculate by the spiral ridges, whereas in the new species, there are smaller rounded nodules. *P. kilburni* has a less dome-shaped protoconch. Regarding the spiral sculpture, *P. stipendiarii* differs in possessing spiral lirae that have distinctly serrulated edges (corresponding to "state 4" of Kilburn, 1993), whereas in *P. kilburni* the crests are irregularly nodose-pliculate ("state 3") (Figures 5, 6). Furthermore, *P. kilburni* bears fewer spiral lirae on the penultimate whorl (17–23 versus 27–33) and on the base

(30–35 instead of 40–50); the interstices between spiral lirae are much wider in the new species than in *P. stipendiarii*. The new species lacks denticles on the outer lip, whereas in *P. stipendiarii* there are approximately 14–16.

Finally, it should be noted that *P. stipendiarii* and *P. kilburni* are allopatric species, and no sign of intergrading is detectable in the type series of the latter, which shows a considerable degree of uniformity.

Under SEM, the new species was found to show a microsculpture of prickly granules in the interior part of the inner lip and prickly pustules in the interior part of the lip edge (Figures 7–10). These microsculptural elements have not previously been adequately figured and described. Judging from our SEM observations, similar granules are present within the family Turridae *s.l.* in several genera and even subfamilies. The systematic value of these micro features has not yet been adequately investigated. Their significance will probably be understood when enough species are known.

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***Diplommatina chaoi* (Prosobranchia: Diplommatinidae), A New Species from Southern Taiwan**

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Introduction

The family Diplommatinidae Pfeiffer, 1856, is distributed in Asia, Europe, and Central America (Thiele, 1992). It comprises two subfamilies: Diplommatininae Pfeiffer, 1856, and Cochlostomatinae Tielecke, 1940 (Solem, 1959). Most of the species of Asian Diplommatinidae belong to the subfamily Diplommatininae. Nine of the 10 described species and subspecies of diplommatinines in Taiwan belong to the subgenus *Sinica* Moallendorff, 1885, of the genus *Diplommatina* Benson, 1849, and the other belongs to the genus *Palaina* Semper, 1865 (Kuroda, 1941; Pilsbry & Hirase, 1905).

Nine specimens of *Diplommatina* were collected in Pingtung County on 25 August 1997, and six in Taitung County on 27 August 1997 (Figure 1). Comparisons of morphological characters with other species revealed that the present specimens differ from all recognized species in the genus. This new species is described below.

Diplommatina (*Benigoma*) *chaoi* Hwang, Chang & Chang, sp. nov.

(Figures 2–5, 7)

Description: The shell is minute, 3.67–4.44 mm long, dextral, turreted, and red-brown in color. The number of whorls is 7.5–8.75. The upper five whorls are slightly transparent. The first six whorls are strongly convex. The apex is concave in outline due to allomorphic expansion of the upper whorls. The penultimate whorl is the widest. The body whorl is slightly narrower than the penultimate whorl.

The first two whorls are embryonic whorls with smooth surfaces. The lower three-fourths of the third to fifth whorls is ornamented with thin, curved, axially lamellate ribs when unworn. There are 17 to 19 ribs on each ornamented whorl. The spaces between ribs vary on the three whorls from 0.16 mm to 0.27 mm in width, gradually becoming more widely spaced toward the fifth

whorl. The penultimate whorl and the first half of the body whorl are smooth, but have short, straight, oblique striae below the suture. The last half of the body whorl has very fine and dense striae (Figure 3). The umbilicus is closed. A transverse lamella (TL) is situated in the last whorl above the aperture on the outer wall (Figure 5). The upper end of the transverse lamella reaches the suture but does not extend farther onto the parietal wall. The first parietal lamella (PL1) is close to the suture, and the second parietal lamella (PL2) is close to the columella. The former is more elevated and longer than the latter. The first and second parietal lamellae reach a quarter of a whorl in length on the roof of the body whorl (Figure 7). A palatal plica is absent.

The aperture is subspherical. The peristome is thickened, expanded, and doubled, but not reflected. The parietal callus is thin. The columellar lamella is strong, pointed downward from aperture view, extended, and reaches half a whorl in length, not close to the transverse lamella, and slightly concave along its dorsal side (Figure 5).

The operculum is thin, semitransparent, and multispiral.

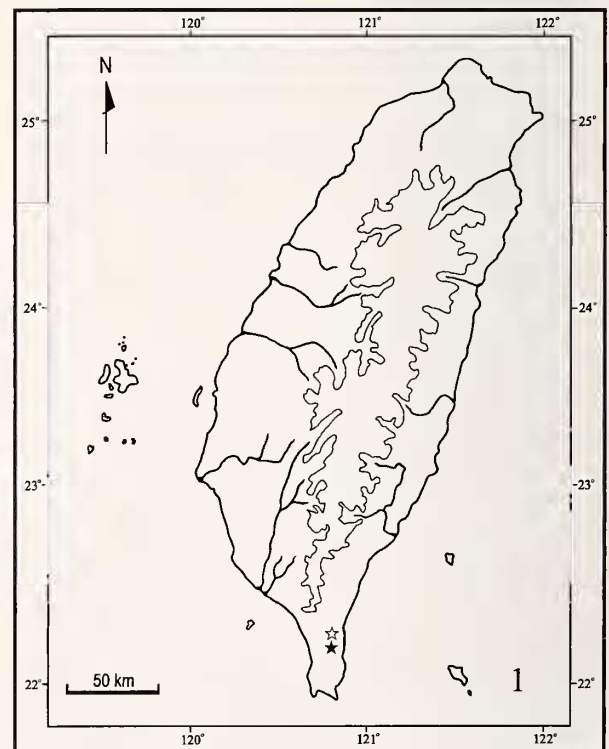


Figure 1. Map of Taiwan. ★ Type locality of *Diplommatina chaoi* Hwang, Chang & Chang, sp. nov. (Neiwen, Shih-tzu, Pingtung County); ☆ Another locality (Kueitien, Dajen, Taitung County).

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